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# 2016

## M.Sc.

## 1st Semester Examination

## ELECTRONICS

### PAPER—ELC-101

*Full Marks* : 50

*Time* : 2 Hours

*The figures in the right-hand margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*Illustrate the answers wherever necessary.*

**(*Mathematical Methods and Numerical Analysis*)**

Answer *Q. No. 1* and any *three* questions from the rest.

1. Answer *all* questions : 5×2

   (a) What are absolute and relative errors?

   (b) Show that $E = 1 + \Delta$

   where $E$ = shift operator.

*(Turn Over)*

(c) Find the inverse Laplace transform of

$$\frac{S^2 - 3S + 4}{S^3}.$$

(d) If $w = \log z$, find $\frac{dw}{dz}$ & determine where w is analytic.

(e)

| | | | |
|---|---|---|---|
| x | 1 | 2 | 3 |
| f(x) | 5 | 10 | 15 |

for what value of x, f(x) = 7.

2. (a) Deduce an expression for Newton's forward interpolation polynomial. 4

(b) The following table gives distance in nautical miles of the visible horizon for the given heights in feet above the earth surface :

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| x | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| y | 10.63 | 13.03 | 15.04 | 16.81 | 18.42 | 19.9 | 21.27 |

Find the value of y when x = 218 ft. 6

3. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using

(i) Trapezoidal rule ;

(ii) Simpson's $\frac{1}{3}$ rule ;

(iii) Simpson's $\frac{3}{8}$ rule ;

Compare the results. 3×3+1

4. (a) Prove that the remainder in approximating f(x) by the interpolation polynomial using interpolating points $x_0, x_1, x_2, \ldots, x_n$ is of the form

$$\frac{w(x)\, f^{(n+1)}(l\xi)}{(n+1)!}$$

where $w(x) = (x - x_0)(x - x_1)(x - x_2) \ldots (x - x_n)$ and $l\xi$ lies between the smallest and the longest of the numbers $x_0, x_1, \ldots, x_n$. 5

(b) If f(z) is analytic within and on a closed curve C and if 'a' is any point within C, then show that

$$f(a) = \frac{1}{2\pi i} \int_C \frac{f(z)\,dz}{z-a}.$$ 5

5. (a) Describe the floating point representation of a real number on a computer memory location. 4

(b) Solve the initial value problem

$$\frac{dy}{dx} = x - y^2,\ y(0) = 1$$

to find y(0.4) by second order Runge-Kutta method using step length 0.1 . 6

**6.** (a) Prove that $\frac{d}{dx}\left[x^n J_n(x)\right] = x^n J_{n-1}(x)$

where $J_n(x)$ is a Bessel function of first kind of order n. 5

(b) Suppose the random variables X and Y have joint density function

$$f(x,y) = \begin{cases} e^{-y}, & \text{if } 0 < x < y < \infty \\ 0, & \text{otherwise}. \end{cases}$$

Find the conditional density function of X given that Y = y. 5

**Internal Assessment — 10 Marks**

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